8

ENGINEERING CHANGE NOTICE	1. ECN 643410
Page 1 of 2	Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [X] Direct Revision ~~[X]~~ Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	B. C. Simpson, LMHC, R2-12 373-5915	[] Yes [X] No	08/20/97
	6. Project Title/No./Work Order No. Tank 241-U-204	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-486, Rev. 0B	10. Related ECN No(s). NA	11. Related PO No. NA

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change — 13b. Design Baseline Document? [] Yes [X] No

Add Appendix H, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-U-204.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-U-204 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

15. Distribution (include name, MSIN, and no. of copies)

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	R. T. Winward	H5-49
File	H5-49	K. E. Bell	R2-12
B. C. Simpson	R2-12		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

RELEASE STAMP

DATE: HANFORD RELEASE
STA: 4 ID: 2
AUG 28 1997

A-7900-013-2 (05/96) GEF095

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng.	M. J. Kupfer *M J Kupfer*	8-22-97	PE		
Cog. Mgr.	K. M. Hodgson *K.M. Hodgson*	8-25-97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other	K. E. Bell *Kevin E Bell*	8-25-97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-U-204

B. C. Simpson (LMHC) and R. T. Winward (Meier Associates)
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 643410 UC: 712
Org Code: 74610 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 127

Key Words: TCR, best-basis inventory

Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-U-204 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

L. E. Fox
Release Approval

8/28/97
Date

DATE: HANFORD RELEASE
STA: 4
ID: 2.
AUG 28 1997
Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-486	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-U-204

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 07/28/95 on EDT-612168.	G.F. Raphael	J.G. Kristofzski
0-A RS	Incorporate per ECN-625677.	L.M. Sasaki L.M. Sasaki	J.G. Kristofzski J Kristofzski 8/31/95
0-B RS	Incorporate per ECN-625697.	L.M. Sasaki L.M. Sasaki	J.G. Kristofzski JGK 9/20/95
0-C RS	Incorporate per ECN-643410	M.J. Kupfer MJ Kupfer 8-27-97	K.M. Hodgson K.M. Hodgson 8-25-97

A-7320-005 (08/91) WEF168

APPENDIX H

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-U-204

This page intentionally left blank.

APPENDIX H

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-U-204

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-U-204 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

H1.0 CHEMICAL INFORMATION SOURCES

Available chemical information for tank 241-U-204 include the following:

- Data from two push mode cores taken in 1995 from tank 241-U-204 (Section 4.0 and Appendix A).
- Data from other tanks containing Reduction and Oxidation (REDOX) process (R)/REDOX cladding waste (CWR1) sludge, tanks 241-S-104 and 241-S-107 (DiCenso et al. 1994, Simpson et al. 1996).
- The inventory estimate for this tank generated from the Hanford Defined Waste (HDW) model (Agnew et al. 1997a), developed at Los Alamos National Laboratory (LANL).

H2.0 COMPARISON OF COMPONENT INVENTORY VALUES

A sample-based inventory estimate was not previously calculated for this tank. The HDW model estimates (Agnew et al. 1997a) for tank 241-U-204 are shown in Table H2-1 and H2-2. The chemical species are reported without charge designation per the best-basis inventory convention.

The HDW inventory estimates uses a solid waste volume of 7.6 kL (2 kgal), a supernatant volume of 3.8 kL (1 kgal), and an overall waste density of 1.51 g/mL. Note that the HDW model has been updated since the initial publication of this Tank Characterization

Report (TCR), therefore, many of the values cited from the current version of the HDW model are not consistent with the version cited in the body of this TCR.

The calculation of a separate supernatant contribution will be excluded in the development and comparison of data-based inventory estimates, because the inventory contributions from the supernatant (except for water) are typically within the calculated uncertainty. However, the total inventory estimate and volume (supernatant and sludge) from the HDW will be used as a basis for comparison.

Table H2-1. Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-U-204.

Analyte	HDW[a] inventory estimate (kg)	Analyte	HDW[a] inventory estimate (kg)
Al	2,290	NO_3	269
Bi	0	OH	5,370
Ca	36.6	oxalate	0
Cl	1.90	Pb	185
Cr	0.80	P as PO_4	0
F	0	Si	4.27
Fe	69.7	S as SO_4	6.10
Hg	6.20	Sr	0
K	0.46	TIC as CO_3	54.9
La	0	TOC	0
Mn	0	U_{TOTAL}	327
Na	1,370	Zr	0
NH_3	1.53	H_2O (wt%)	41.2
Ni	0.45	density (kg/L)	1.51
NO_2	334		

HDW = Hanford Defined Waste
[a] Agnew et al. (1997a).

Table H2-2. Hanford Defined Waste Predicted Inventory Estimates for Radioactive Components in Tank 241-U-204.

Analyte	HDW[a, b] inventory estimate (Ci)	Analyte	HDW[a, b] inventory estimate (Ci)
^{90}Sr	15.5	^{239}Pu	12.2
^{137}Cs	17.8	^{240}Pu	1.72

HDW = Hanford Defined Waste
[a] Agnew et al. (1997a).
[b] The HDW model Rev. 4 reports inventories for 46 radionuclides. Only the four most significant are reported in this table. Radionuclides are decayed to January 1, 1994.

H3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed in order to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories. The types and volumes of solids accumulated in tank 241-U-204 reported by various authors is compiled in Table H3-1.

H3.1 CONTRIBUTING WASTE TYPES

The process history documents indicate the tank received mostly cladding waste from REDOX (CWR1) while the tank was active. Tank 241-U-204 went into service in 1956 receiving CWR1 from tank 241-U-110 through a diversion box (Agnew et al. 1997b). Before receiving CWR1, approximately 4,500 kL (1,190 kgal) of REDOX high-level (R) waste had been transferred through tank 241-U-110. The waste transferred to tank 241-U-204 may have been a combination of CWR1 and R waste types. For the remainder of its service life (1956 to 1977) tank 241-U-204 stored CWR1 (Agnew et al. 1997b).

Agnew et al. (1997b): CWR1
Hill et al. (1995): CW

CWR1 = REDOX process cladding waste (aluminum clad fuel--1952 to 1960)
CW = cladding waste

Current surveillance data (Hanlon 1997) provides estimated volumes for these waste types. Agnew et al. (1997a) uses these values for bases as well. There has been no change, such as salt well pumping, to alter the volumes. These are the values in Table H3-1 used to derive inventories. The total volume is used in calculating inventories.

Table H3-1. Waste Volumes for Tank 241-U-204.

HDW[a] volumes	kL	kgal	Surveillance volumes[b]	kL	kgal
CWR1	7.6	2	sludge	7.6	2
supernatant	3.8	1	supernatant	3.8	1
Total tank	11.4	3	Total tank	11.4	3

CWR = Reduction and Oxidation (REDOX) cladding waste
HDW = Hanford Defined Waste
[a] Agnew et al. (1997a)
[b] Hanlon (1997).

H3.2 ASSUMPTIONS

The following evaluation provides an engineering assessment of tank 241-U-204 contents. For this evaluation, the following assumptions and observations are made:

- The inventory estimate using data solely from tank 241-U-204 is calculated using the measured density from the sample data (1.31 g/mL) and the solids tank volume listed in Hanlon (1997).. The Agnew et al. (1997a) estimates have a different overall density basis (1.51 g/mL).

- A typical sludge composition can be estimated by using sample-based concentrations from similar wastes (e.g., tanks 241-S-104, 241-S-107, and 241-U-204 [DiCenso et al. 1994, Simpson et al. 1995, and Raphael and Tran 1995]) for calculating the predicted engineering data set. The tank waste mass in this estimate is calculated using the measured average density from similar tanks (1.61 g/mL) and the total tank volume listed in Hanlon (1997).

- Only the CWR1 and R sludge waste streams contributed to solids formation.

- A limited amount of analytical data is available from tank 241-U-204.

- No radiolysis of NO_3 to NO_2 is factored into this evaluation.

H3.3 BASIS FOR CALCULATIONS USED IN THIS ENGINEERING EVALUATION

The general approach in this engineering assessment is to identify waste types and their approximate volumes within the tank of interest. The sources of information may include analytical data from samples taken from the tank of interest, analytical data from other tanks believed to contain waste types similar to those believed to be in the tank of interest, and data from models utilizing historical process records. The confidence level assigned to the best-basis inventory values then depends on the level of agreement among the various information sources. This approach is, of course, best suited for cases where extensive analytical data exist from multiple sampling events from a number of tanks containing similar waste types.

The CWR1 sludge concentrations used in the engineering assessment were developed with analytical data taken from tanks 241-U-204, 241-S-104, and 241-S-107. The data from tank 241-U-204 are included in the assessment because they apply to, and are used in, the inventory calculation of other 241-U-200 series tanks. In this particular case, including tank 241-U-204, the data causes some circularity in the engineering assessment. However, the tank data-based inventory will be evaluated on its own in a separate set of calculations. Some REDOX process waste may be intermixed in tank 241-U-204. However, the same situation applies in the tanks used to predict the REDOX high-level waste generated between 1952 to 1957 (R1) waste concentration. Thus, the waste is considered a mixture. Data were selected based on Agnew et al. (1997a) predicted sludge location.

The concentrations from each tank and the segments used in the calculation are shown in Table H3-2. In many cases, data from several sources were assessed and used, some data sets were selected in favor of others (usually when evidence of bias or high variability was observed), and some of the average values include detection limit values, where additional data suggest the detection limits are high. The mean from each specified set of tank data was averaged to obtain the projected concentration for each analyte for the sludge. The HDW model values for CWR1 sludge are also listed in Table H3-2 for comparison with the data-derived values.

Table H3-2. Mean Sludge Composition Estimate for 241-U-200 Tanks (2 Sheets)

Analyte	Tanks (segments)			Average concentration[d] (μg/g)	HDW model CWR1 concentration[e] (μg/g)
	241-S-104[a] (all) (μg/g)	241-S-107[b] (segments) (μg/g)	241-U-204[c] (average) (μg/g)		
Al	117,000	56,400	221,000	132,000	171,000
B	26.6	49	<DL	38	NR
Bi	<45.7	NR	1,200	<623	0
Ca	247	234	1,260	580	2,730
Cl	3,200	1,860	100	1,720	141
Cr	2,350	1,180	391	1,310	59.8
F	145	150	4,000	1,430	0
Fe	1,720	1,160	2,720	1,870	5,200
K	300	457	220	326	33.9
Mn	1,150	83	82	438	0
Na	121,000	60,400	18,200	66,500	102,000
Ni	56	206	3,940	1,400	33.7
NO_2	25,900	34,300	3,000	21,100	24,900
NO_3	191,000	57,600	12,000	86,900	20,000
Pb	29.6	33	7,300	2,450	13,800
PO_4	<2,190	1,630	2,150	<1,990	0
Si	1,330	1,060	2,390	1,590	319
SO_4	2,270	1,300	513	1,360	455
Sr	424	378	33.9	279	0
TOC	1,730	NR	471	1,100	0
U	6,690	8,686	1,410	5,600	24,400
Zn	20.1	24	902	315	NR
Zr	33.6	131	26.4	63.7	0
density	1.64	1.90	1.31	1.62	1.77
Radionuclides[f] (μCi/g)					
^{137}Cs	60.5	276	3.96	113	1.33
^{90}Sr	301	74	0.0092	125	1.16
$^{239/240}$Pu	0.282	NR	0.097	0.19	1.04

Table H3-2. Mean Sludge Composition Estimate for 241-U-200 Tanks (2 Sheets)

Analyte	Tanks (segments)			Average concentration[d] (μg/g)	HDW model CWR1 concentration[e] (μg/g)
	241-S-104[a] (all) (μg/g)	241-S-107[b] (segments) (μg/g)	241-U-204[c] (average) (μg/g)		

DL = Detection limit
HDW = Hanford Defined Waste
NR = Not reported
[a] DiCenso et al. (1994)
[b] Statistically determined median R1 sludge concentrations for tank 241-S-107 contained in attachment to Simpson et al. (1996)
[c] Raphael and Tran (1995)
[d] Average of analyte concentrations for tanks 241-S-104, 241-S-107, and 241-U-204
[e] Agnew et al. (1997a)
[f] Radionuclides decayed to January 1, 1994.

H3.4 INVENTORY COMPARISONS

Table H3-3 contains the total engineering assessment-based inventories calculated by developing the waste inventories using an average composition from tanks 241-S-104, 241-S-107, and 241-U-204 to produce the tank inventory as shown below. Calculations for Table H3-3 are: (three tank average or tank specific analyte concentration in μg/g) x (total waste [2 kgal]) x 3,785 L/kgal x 1,000 mL/L x (density [1.62 or 1.31 g/mL for the three tank average or data-based case respectively]) x kg/(1 E+09) μg = total kg for this waste type in the tank.

Table H3-3. Comparison of Hanford Defined Waste-Based, Average Concentration, and Data-Based Inventory Estimates for Tank 241-U-204. (2 Sheets)

Element	241-U-204 data-based estimate (kg)	241-U-204 three tank average concentration estimate (kg)	241-U-204 HDW estimate[a] (kg)
Al	2,190	1,620	2,290
Bi	11.9	<7.64	0
Ca	12.5	7.11	36.6
Cl	1.00	21.1	1.90
Cr	3.88	13.9	0.80
F	39.7	17.5	0

Table H3-3. Comparison of Hanford Defined Waste-Based, Average Concentration, and Data-Based Inventory Estimates for Tank 241-U-204. (2 Sheets)

Element	241-U-204 data-based estimate (kg)	241-U-204 three tank average concentration estimate (kg)	241-U-204 HDW estimate[a] (kg)
Fe	27.0	22.9	69.7
Pb	72.4	30.0	185
Mn	0.81	5.37	0
Ni	39.0	17.2	0.45
NO_3	119	1,070	269
NO_2	30.0	258	334
PO_4	21.3	24.4	0
K	2.18	3.99	0.46
Si	23.7	19.5	4.27
Na	180	816	1,370
Sr	0.34	3.42	0
SO_4	5.09	16.7	6.10
TOC	4.67	13.5	0
U	14	68.7	327
Zn	8.94	3.86	NR
Zr	0.26	0.78	0
Density (g/mL)	1.31	1.62	1.51
wt% H_2O	29.0	28.1	41.2
Radionuclides[b] (Ci)			
^{137}Cs	39.3	1,390	17.8
^{90}Sr	0.11	1,530	15.5
$^{239/240}Pu$	1.18	2.33	13.9

HDW = Hanford Defined Waste
[a]Agnew et al. (1997a)
[b]Radionuclides decayed to January 1, 1994.

H3.5 DOCUMENT ELEMENT BASIS

This section compares the sample-based estimate, the engineering assessment, and the inventory estimate calculated by the HDW model for selected analytes. Many of the differences observed between the estimates can be attributed to the differences in their respective mass bases. In other cases, the source term for the analyte in the waste type does not appear to be accurately described. Several analytes such as bismuth, nickel, manganese, phosphate, and TOC are not principal process chemicals in the CWR1 waste, but may be present in larger than expected amounts as a result of mixing with the first cycle bismuth phosphate process waste present in tank 241-U-110.

Aluminum. The three estimates qualitatively agree that aluminum is a substantial contributor to the waste. The tank 241-U-204 data-based inventory is approximately 30 percent different than the three tank average-based inventory. The three tank average-based inventory is about 35 percent different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is approximately 4 percent different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Nitrate. The three estimates qualitatively agree that nitrate is a modest-to-substantial contributor to the waste, however, they are highly variable. The tank 241-U-204 data-based inventory is approximately a factor of 9 different than the three tank average-based inventory. The three tank average-based inventory is about a factor of 4 different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is approximately a factor of 2 different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Nitrite. The three estimates qualitatively agree that nitrite is a modest contributor to the waste, however, they are highly variable. The tank 241-U-204 data-based inventory is approximately a factor of 9 different than the three tank average-based inventory. The three tank average-based inventory is about 26 percent different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is approximately an order of magnitude different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Lead. The three estimates qualitatively agree that lead is a modest contributor to the waste, and they are somewhat variable. The tank 241-U-204 data-based inventory is approximately a factor of 3 different than the three tank average-based inventory. The three tank average-based inventory is about a factor of 6 different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is approximately a factor of 2.5 different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Sodium. The three estimates qualitatively agree that sodium is a substantial contributor to the waste. The tank 241-U-204 data-based inventory is approximately a factor of

4.5 different than the three tank average-based inventory. The three tank average-based inventory is about a factor of 2 different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is approximately a factor of 7 different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Total Hydroxide. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures is not increased. This charge balance approach is consistent with that used by Agnew et al. (1997a).

Uranium. The three estimates qualitatively agree that uranium is a modest-to-low contributor to the waste, however, they are highly variable. The tank 241-U-204 data-based inventory is approximately a factor of 5 different than the three tank average-based inventory. The three tank average-based inventory is about a factor of 5 different than the HDW model-based inventory. The tank 241-U-204 data-based inventory is over a factor of 20 different than the HDW model-based inventory. The differences in the source term concentrations and density values are the reasons for the observed discrepancies.

Water. The three tank average concentration and tank 241-U-204 data-based estimates are very close. They qualitatively agree that water is a principal contributor to the waste in this tank. The HDW estimate is much higher. However, because of the volatility of water over time, the degree of discrepancy observed is expected between the HDW and data-based estimates.

H4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage/disposal.

Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using results of sample analyses, (2) component inventories are estimated using the HDW model-based on process knowledge and historical information, or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. The information derived from these different approaches is often inconsistent

An evaluation of available chemical information for tank 241-U-204 was performed, including the following:

- An inventory estimate generated by the HDW model (Agnew et al. 1997a)
- A data-based inventory developed from concentration information from similar tanks (including tank 241-U-204).
- A data-based inventory developed from selected concentration information taken solely from tank 241-U-204.

Based on this evaluation, a best-basis inventory was developed for tank 241-U-204. Limited sampling information was available for tank 241-U-204, however, several analytes were not assayed. The single tank data-based inventory was chosen as the best basis for those analytes for which sample-based analytical values were available for the following reasons:

- No independent data sources are available to predict CWR1 compositions from process flowsheet or historical records
- The data-based inventory estimates appear reasonable, given the process knowledge available.
- For those few analytes where no values were available from the data-based inventory, or the estimate was considered suspect, the HDW model values were used.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

The best-basis inventory for tank 241-U-204 is presented in Tables H4-1 and H4-2. The inventory values reported in Tables H4-1 and H4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table H4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-U-204 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	2,190	S	
Bi	11.9	S	
Ca	12.5	S	
Cl	1.0	S	
TIC as CO_3	54.9	M	
Cr	3.88	S	
F	39.7	S	
Fe	27	S	
Hg	6.20	M	
K	2.18	S	
La	0	M	
Mn	0.81	S	
Na	180	S	
Ni	39.0	S	
NO_2	30.0	S	
NO_3	119	S	
OH_{TOTAL}	4,210	C	Derived from charge balance
Pb	72.4	S	
PO_4	21.3	S	
Si	23.7	S	
SO_4	5.09	S	
Sr	0.34	S	
TOC	4.67	S	
U_{TOTAL}	14	S	
Zr	0.26	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table H4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-204 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	0.0077	M	
^{14}C	8.26 E-04	M	
^{59}Ni	2.34 E-04	M	
^{60}Co	3.57 E-04	M	
^{63}Ni	0.022	M	
^{79}Se	1.80 E-04	M	
^{90}Sr	0.11	S	
^{90}Y	0.11	S	Referenced to ^{90}Sr.
^{93}Zr	8.50 E-04	M	
^{93m}Nb	6.91 E-04	M	
^{99}Tc	0.0059	M	
^{106}Ru	2.09 E-09	M	
^{113m}Cd	0.0026	M	
^{125}Sb	5.97 E-04	M	
^{126}Sn	2.73 E-04	M	
^{129}I	1.14 E-05	M	
^{134}Cs	1.25 E-05	M	
^{137}Cs	39.3	S	
^{137m}Ba	37.2	S	
^{151}Sm	0.641	M	
^{152}Eu	0.0013	M	
^{154}Eu	0.0087	M	
^{155}Eu	0.063	M	
^{226}Ra	2.14 E-08	M	
^{227}Ac	1.10 E-07	M	
^{228}Ra	2.21 E-12	M	
^{229}Th	3.12 E-10	M	
^{231}Pa	2.60 E-07	M	
^{232}Th	3.05 E-13	M	
^{232}U	4.89 E-06	M	
^{233}U	1.81 E-07	M	

Table H4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-U-204 Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{234}U	0.112	M	
^{235}U	0.0048	M	
^{236}U	0.0025	M	
^{237}Np	4.15 E-05	M	
^{238}Pu	0.190	M	
^{238}U	0.109	M	
$^{239/240}Pu$	1.18	S	
^{241}Am	3.09 E-03	M	
^{241}Pu	10.5	M	
^{242}Cm	2.77 E-05	M	
^{242}Pu	4.45 E-05	M	
^{243}Am	2.82 E-08	M	
^{243}Cm	6.31 E-07	M	
^{244}Cm	9.83 E-07	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based, Agnew et al. (1997a)
E = Engineering assessment-based.

This page intentionally left blank.

H5.0 APPENDIX H REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T B. Duran, J. R. FitzPatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Waste Status and Transaction Record Summary (WSTRS Rev. 4)*, LA-UR-97-311 Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

DiCenso, A. T., L. C. Amato, J. D. Franklin, G. L. Nuttall, K. W. Johnson, P. Sathyanarayana, and B. C. Simpson, 1994, *Tank Characterization Report for Single-Shell Tank 241-S-104,* WHC-SD-WM-ER-370, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending March 31, 1996*, HNF-EP-0182-108, Lockheed Martin Hanford Corporation, Richland, Washington.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

Hodgson, K. M., and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, and R. A. Watrous (LMHC), S. L. Lambert, and D. E. Place (SESC), R. M. Orme (NHC), G. L. Borsheim (Borsheim Associates), N. G. Colton (PNNL), M. D. LeClair (SAIC), R. T. Winward (Meier Associates), and W. W. Schulz (W^2S Corporation), 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Simpson, B. C., J. G. Field, D.W. Engel, and D. S. Daly, 1996, *Tank Characterization Report for Single-Shell Tank 241-S-107*, WHC-SD-WM-ER-589, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989,* HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

This page intentionally left blank.